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ABSTRACT

In the 1960s there developed a growing interest in and supportive evidence for programs to alter intellectual competence, particularly in young children. The abilities concept, which is used to classify people by abilities, is not well suited to teaching intellectual competencies or assessing changes in competence. A new concept, intellectual skill, is needed to serve as a basis for specifying behaviors which underlie task mastery. An intellectual skill may be defined as a behavioral capability that functions to facilitate the performance of a culturally relevant task. Three criteria for distinguishing intellectual skills from other behavioral phenomena are: (1) a definition of skill behavior in performance terms; (2) demonstration of transfer effects; and (3) use of tasks that are culturally relevant. The intellectual skills concept can be applied to curriculum design and psychological services. The writer used the latter application in a consultation process model. The consultation approach offers several advantages: (1) it provides data showing the functional relationship between the teaching of skills and the accomplishment of a criterion task; (2) it can validate the applicability of research findings and serve as a means of generating hypotheses for controlled laboratory research; (3) the time series design is efficient and practical; (4) it offers immediacy of application; and (5) it demands that the problem be identified in performance terms. References are provided. (KM)

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INTELLECTUAL SKILLS: AN EMERGING CONCEPT FOR A CHANGING SOCIETY[1]

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For the better part of a century, conceptions of intellectual competence in Western culture have been dominated by the concept of intellectual abilities. The central use of the abilities concept has been to classify people. Ability classifications have served the important purpose of facilitating society's access to human resources by providing an economical means for identifying those individuals whose intellectual competencies could be harnessed to the complex tasks of a technological age.

In recent years the use of the abilities concept has extended beyond classification. At the beginning of the 1960's, McV. Hunt (1961) marshalled evidence challenging long dominant assumptions of genetically fixed intelligence and pre-determined intellectual development. In light of this challenge, some educators began to take seriously the notion that intellectual competence could be changed through instruction and, by the middle of the 1960's, programs were developed which were committed to the task of teaching abilities to young children. Bissell (1970), in a recent review of such programs, has indicated that structured pre-school experiences can have a facilitating effect on intellectual competence as measured by such tests as the Stanford-Binet Intelligence Scale and the Illinois Test of Psycholinguistic Abilities.

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In light of the growing interest in and supportive evidence for programs to alter intellectual competence, it is important to examine the role of the abilities concept in the assessment of changes in competence. As mentioned above, the abilities concept has been used primarily for classification purposes, not for purposes of assessing change. The movement of the nation to a consideration of procedures for modifying intellectual capabilities calls for a new examination of the abilities concept and raises the question of whether or not the concept ought to be augmented by another concept specifically designed to reflect capability change.

Intellectual Abilities

Abilities and Prediction

The term ability may be described quite simply as behavior which an individual can emit. The simplicity of this denotation belies the fact that abilities are defined empirically by an elaborate set of conventions designed to serve the purpose of predicting behavior.

The conventions of the prediction paradigm are familiar to every psychologist: 1. Test items chosen to measure abilities are selected so as to maximize individual differences in performance. Items which too many people pass or too many people fail are excluded because they do not help to maximize individual differences. 2. Since the purpose of ability measurement is to predict performance, validity is established by correlating ability measures with criterion measures. 3. Since accurate prediction requires stability in individual differences, reliability is established by assessing the extent to which individual differences are consistent within a test, or between two forms of the same test, or over time. 4. An individual's test performance is described by stating his

position in a reference group. 5. Finally, abilities are defined, typically through factor analytic procedures, on the basis of clusterings of correlations.

Abilities and Instruction

Whenever there is a need to select individuals for inclusion in or exclusion from a given group on the basis of predicted criterion performance, the ability concept is of value. Despite its value for selection purposes, however, the ability concept is not well suited to the task of teaching intellectual competencies. One problem associated with the concept is that it does not require behavioral definition of abilities. Because behavioral definition is lacking, there is no clear basis for determining what behaviors should be taught to increase a given ability. For example, consider tasks such as those used in the similarities subtest of the Wechsler Adult Intelligence Scale (Wechsler, 1955). The items on this subtest require the examinee to specify the manner in which two things are alike. The examinee's answers for each item are recorded, but the behaviors responsible for producing those answers are not indicated. Because behavioral specificity is lacking, it is difficult to determine what behaviors to teach to increase the ability measured by the similarities subtest.

A second problem associated with the abilities concept is lack of sampling specificity. When a sample of items is selected to represent a population, the population and the sampling procedure should be specified. Such specification is lacking in virtually all ability tests. When the population of items underlying a subtest sample is not specified, it is not possible to devise a sampling procedure to assist in relating ability

instruction to ability assessment. Consider the case of a vocabulary subtest such as that used in the Stanford Binet Scale (Terman and Merrill, 1960). If one were to teach the words on the subtest, one would be accused of teaching the test and not the ability measured by the test. If one were systematically to avoid subtest words, presumably there would be little change in future performance on the subtest. It is impossible to establish any practical way to select words to relate instruction to ability assessment because the population of words used to construct the test is not specified.

The procedure of describing individual performance in terms of position in a norm group is another shortcoming of the ability concept. Norm referenced scores obscure information about what a student can or cannot do by substituting for such information nothing more than a description of group position (Glaser, 1963).

Norm referenced scores obscure behavioral change as well as behavioral specificity. The most direct way to measure ability acquisition would be to assess the extent to which an individual's performance of an ability behavior changed over time. Acquisition typically is not assessed in this fashion. It is measured not by change in performance, but rather by change in group position. Consider a group of ten first-grade children who differ in the ability to remember sequences of digits. By the time the children are third-graders, their memories will probably all have improved, but their relative positions in the group may tend to remain constant. In order for a child to demonstrate a change in ability, he must be able to show not merely that his performance has improved, but that the improvement has been at a faster rate than is the case for others

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in an appropriate reference group. When change is measured against a standard (the norm group) which is itself changing, the apparent extent of change necessarily will be attenuated.

A final difficulty with the ability concept has to do with the purpose of ability training. Presumably, the purpose of ability training is to provide competencies which assist an individual to accomplish criterion tasks which he otherwise might not have been able to accomplish. Accordingly, it is reasonable to expect that the criterion tasks be specified and that the influence of ability training on criterion task performance be demonstrated. Ability tests do not specify the manner in which ability behaviors influence criterion task performance. They indicate only position in a reference group.

The problem of the ability concept with respect to the purpose of ability training is clearly illustrated in recent efforts to base ability training programs on scores obtained on diagnostic ability tests. The general format for the construction of diagnostic ability tests includes a series of subtests under a heading such as language abilities. Typically each of the subtests is assumed to measure a separate ability. A child receives a score on all subtests as well as total score. These scores are in essence standard scores which specify the child's position with respect to a norm group. The child is given a profile which indicates for each subtest the extent to which his performance deviates from the average. Instruction is often prescribed on the basis of the profile. For example, if a child is above average on six subtests and below average on three, it may be suggested that he receive instruction in the three areas in which his performance is low.

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The basic task which diagnostic ability tests are designed to accomplish presumes empirical demonstration of ability training benefits with respect to the performance of criterion tasks. Unfortunately, diagnostic ability tests indicate only group position. Criterion task performance to be facilitated by ability training is often not even specified.

Intellectual Skills

Need for the Concept

The above discussion suggests the need for a new approach to the teaching of intellectual competencies. The concept of ability has been linked for so long to prediction conventions that it is doubtful that new meanings could be attached to it without creating a great deal of confusion. Yet, there is a need for a concept in many respects analogous to that of ability.

Radical behaviorists, operating as through there were no justification for an ability concept, have attempted to alter learning by applying a single set of procedures to all individuals regardless of individual differences in the kinds of competencies brought to the learning task. Certain behaviors have proven to be extremely resistant to change under procedures advocated by behaviorists (e.g. vida Flavell, 1963). Gagné (1968) has argued quite effectively that the lack of success of the behaviorists can be traced to a failure to determine and to teach those behaviors which are prerequisite to the mastery of learning tasks.

There is a need to establish a concept like that of ability to serve as a basis for specifying behaviors which underlie task mastery. The term intellectual skill shows signs of emerging as a suitable label for such a concept. Although the idea of skill has been linked primarily to the study of motor coordination, it does have properties which make it a

likely choice for use in describing intellectual behaviors. First, although the term intellectual skill has been used to describe intellectual competencies (Resnick, 1967; Gagné, 1970, 1971), it is not yet firmly entrenched in an existing set of technological conventions as is the case with the concept of ability. Thus, the way is open to shape the operational definition of the concept to enhance its usefulness as a tool in the teaching of intellectual competencies. A second desirable property of the term skill is that common usage of the word indicates behavior which can be acquired through instruction. Thus, the spectre of the nature-nurture issue would probably not become involved in debates over the training of intellectual skills to the extent that it has been associated with arguments over the training of intellectual abilities.

Definition

An intellectual skill may be defined as a behavioral capability which, when activated, functions to facilitate the performance of a culturally relevant task. The relationship between behavior and function in this definition is important. According to the definition, an intellectual skill, when activated, is behavior serving a particular kind of function. If the behavior were to occur without its attendant function, it would not be operating as an intellectual skill.

Consider the following mediating response paradigm: $S \rightarrow r \frown s \rightarrow R$ in which S is a stimulus, r a covert response, s the covert response serving as a stimulus for R, the final overt response. Assume that a given individual cannot emit R upon presentation of S without mediation. $r \frown s$, for that individual could be classified as an intellectual skill. r by itself would not be an intellectual skill. r functioning as s signalling the overt response R would be an intellectual skill.

The specification of function as a critical feature of the definition of an intellectual skill is not merely academic nitpicking. It is common practice in existing training programs designed to produce intellectual gains to teach behaviors classified as intellectual competencies without careful specification of, or instruction in, the use of those behaviors.

Defining Attributes

The above definition of intellectual skills suggests three criteria for distinguishing intellectual skills from other behavioral phenomena: The first of these criteria is a definition of skill behavior in performance terms. Gagné (1970) supports this view when he suggests that a prerequisite for identifying intellectual skills in learning hierarchies be a specifiecation of the behaviors in such hierarchies in performance language. The importance of performance specificity is, of course, that it enables educators to define precisely what they are trying to teach. As pointed out above, one of the difficulties with the ability concept is that it does not require performance definition. The above discussion of the problem of lack of performance specificity clearly illustrates the need for making such specificity an essential aspect of intellectual skill definition.

A second criterion suggested for defining an intellectual skill is the demonstration of transfer effects. The most important reason for distinguishing intellectual skills from other behaviors is that it is useful to have a name for those behaviors with transfer properties that facilitate the learning, performance, and/or retention of various criterion tasks. The potential to apply a capability to facilitate the performance

of a criterion task has long been thought to be the hallmark of intelligence. Accordingly, the empirical demonstration of transfer ought to be a criterion for defining intellectual skills.

The final criterion suggested with respect to intellectual skill definition has to do with cultural relevance. In order for a behavior to be classified as an intellectual skill, the tasks used to demonstrate transfer effects for the behavior ought to be of established cultural relevance.

Concern for cultural relevance has always exerted influence on concepts of intellectual competence. Presently, such concern is most clearly evidenced in the convention of establishing the validity of ability tests by correlating them with criterion measures of known relevance. Despite this convention, however, cultural relevance in instruction designed to promote intellectual competence is rarely established.

Conventions for Defining Skills

Just as it was necessary to establish conventions for defining and measuring abilities to serve classification needs, it will be necessary to establish conventions for defining and measuring intellectual skills to be developed to serve instructional needs. There are well known procedures which could be applied as conventions for defining intellectual skills. To meet the criterion of performance definition, available procedures for specifying behavioral objectives (Mager, 1962) could be adapted. If these procedures were used, the class or population of behaviors representing a skill would be specified. Exemplars of the class would be given. The conditions under which the skill is performed would be detailed and the level of acceptable performance defined.

There are several procedures which can be described as conventions for demonstrating transfer. Procedures involving experimental-control comparisons which have long been used in research on learning can be thought of as conventions for revealing transfer. Recently, procedures have been suggested by Gagné (1968), Resnick (1967), and Resnick and Wang (1969) to demonstrate transfer with respect to intellectual skills in learning hierarchies. Finally, the time series design (Campbell and Stanley, 1963), because it requires neither randomization nor controls, is useful for demonstrating transfer in field settings.

Use of the time series design should be linked to controlled experimental research because of validity problems with the design. In the time series design the independent variable is interjected after a series of baseline measurements have been made. Additional measurements are made following introduction of the independent variable. Campbell and Stanley (1963) have listed the sources of invalidity involved in time series experiments. The principle validity problems associated with the design have to do with generalizing results to new populations or settings. Problems of this sort are not always of major concern to educational change agents. For example, if the teacher's problem is to ascertain what will work in his or her classroom, generalization to other classrooms or populations may not be an important issue. An additional validity problem with time series experiments involves the possibility that an event other than the independent variable occurring at approximately the same time as the onset of the independent variable may exert a controlling influence on the dependent variable.

Because the character and needs of a culture change over time, conventions for establishing cultural relevance of transfer tasks associated

with skill behaviors must be based on human judgment rather than objective standards. There are established means in American culture for making judgments as to those tasks which are relevant to cultural goals. The various annual meetings and special conferences of professional groups and the publications of experts in fields related to education provide examples of existing sources for determining relevance at the national level. School boards, parent advisory groups and the like provide important sources for determining cultural relevance at the local level.

Applications of the Intellectual Skills Concept

One promising application of the intellectual skills concept is in curriculum design. Detailed discussions of curriculum applications have been provided by Gagné (1970) and Resnick (1967). These authors describe a number of examples of the identification of intellectual skills forming learning hierarchies underlying the accomplishment of academic tasks. These hierarchies have been used as a basis for specifying what should be taught and in what sequence it should be presented. Instructional sequencing has been individualized by giving students a diagnostic test to determine which intellectual skills they already have in their repertoire and which they need to acquire.

The intellectual skills concept is being used by the present writer in providing psychological services to individual children in a federally funded Follow Through program in public schools. The work of the school psychologist, perhaps more than any other psychological practitioner, has been intimately involved with the concept of intellectual abilities. School psychologists have been given the responsibility of assessing mental ability as a basis for placing children in special education programs. The intellectual skills concept offers a potentially useful

addition to existing tools in school psychology for dealing with problems of intellectual competence.

In the Follow Through project, a consultation process model (Bergan, 1970), conceived in four stages, is used to apply the intellectual skills concept. The first stage in consultation is called problem identification. The goals of problem identification are to specify the existing behavior and goal behavior defining an educational problem. During problem identification, the psychologist assists the educational change agent (typically the teacher, or perhaps a parent) to define in performance terms the behavior with which he or she is concerned and the goal to be achieved with respect to that behavior. Procedures are established to record behavior and baseline records are taken by the change agent. The problem is to change the child's behavior from what it is as revealed in baseline performance to what the change agent and typically the child would like it to be as specified in the statement of goal behavior.

The second stage in consultation is problem analysis. The purposes of problem analysis are to determine requirements for solving the problem and to make a plan to achieve problem solution. Solution requirements are specified through the analysis of external conditions associated with the behavior to be changed and/or component skills analysis (Resnick, 1967). In the case of an intellectual skills problem, analysis begins with a component skills analysis performed by the psychologist. This analysis may be accomplished either by using hierarchies empirically established through research or by generating a tentative list of hierarchically related skills believed to underlie successful performance of the goal behavior. When the list of intellectual skills is identified, the psychologist tests the child to ascertain those skills which he possesses

and those which he does not possess. The psychologist then shares the information from the testing session with the change agent. Together they formulate a plan for teaching and assessing the acquisition of those skills which are believed to underlie successful accomplishment of the goal behavior.

The third stage of consultation is intervention. During this stage the plan devised in problem analysis is implemented. In the case of an intellectual skills problem, the change agent continues to teach the child as he or she did during the collection of baseline data. Data recording is also continued. The teaching of intellectual skills is added to the existing educational program. In the typical case, intellectual skills training is carried out by the change agent at some time of the day other than that during which instruction is aimed at the goal behavior.

The final phase of consultation is evaluation. In the evaluation phase the change agent and the psychologist use data collected during baseline and intervention to determine whether or not the hypothesis with respect to intervention plan effects has been supported. In the event that the hypothesis has been supported and the goal attained, the case may be terminated or another problem selected for consultation. However, post-intervention data may be desirable to ascertain the stability of behavior change. If the goal has not been attained, it is necessary to return to problem analysis to ascertain possible causes for lack of success and to specify an alternate plan.

The following example provided by a psychological consultant in the Follow Through project will serve to illustrate the application of the intellectual skills concept in the consultation process (Brown, personal communication): A fourth-grade boy who will be called Jimmie was re-

ferred to Mr. Brown, the psychological consultant, because he could not do even simple arithmetic problems. Instruction in arithmetic at the time of the referral involved the use of dittoed worksheets containing addition problems. The teacher and other class members were available to answer questions for students experiencing difficulty.

During problem identification, the following goal was selected: Given combinations of two one-digit numbers presented on worksheets, Jimmie will be able to add the two numbers together correctly 100 per cent of the time. A baseline record of addition performance was collected by the teacher over a five day period. The psychologist observed Jimmie twice during arithmetic activities. These informal observations indicated that Jimmie stayed on task most of the time during arithmetic. The teacher corroborated this observation by commenting that Jimmie was a hard worker. The psychologist also observed that there was no discernible reinforcement for poor arithmetic work. Papers completed during arithmetic were put in a folder without comment from the teacher. Praise was sometimes subsequently given for good work, but no criticism seemed to be tendered with respect to bad work.

The above observations led the psychologist to believe that the problem should be attacked from the standpoint of component skills development. Accordingly, the psychologist performed a component skills analysis with respect to the goal behavior and tentatively identified the following prerequisite skill behaviors.

Given visually presented numerals one through twenty, Jimmie will be able to identify the numerals correctly 100 per cent of the time. Given verbal instructions to count to 20, Jimmie will be able to do so with no errors. Given instructions to count up from a number greater

than zero to another specified number no greater than 20, Jimmie will be able to do so with 100 per cent accuracy. Given a printed numeral ranging in value from 0 to 20, Jimmie will be able to represent 100 per cent of the time the value of the numeral by making the correct number of dots with a pencil on the numeral in a specific pattern. Given a printed numeral and a pattern of dots neither of which exceed nine in value, Jimmie will be able to indicate verbally the correct answer to the addition of the dots to the number represented in print 100 per cent of the time. For example, if the problem given were: $2 + \vdots$, the answer would be five.

On the fifth day of baseline the psychological consultant tested Jimmie and found that he could not perform the last three of the five skill behaviors specified above. The consultant shared this information with the teacher, and together they devised a plan to teach the child the tentatively identified skill behaviors. Instruction in addition continued in the manner specified for baseline recording. The basic procedure used to teach all of the skills was first to model the correct responses. Jimmie was then reinforced with verbal praise for correct imitations of the model. Incorrect imitations were followed by further modeling. At the end of each day of training, tests ranging from six to ten items for each skill were administered. Training lasted approximately ten minutes a day for each skill taught. Figure 1 presents the results of the skill training procedure. Performance levels for all three skills were exactly the same for all days of training. These levels are represented by the dotted line in the figure. Performance for all three skills reached

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Insert figure 1 about here

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100 per cent accuracy on the first day of training. Four subsequent days of training were given to insure stability of performance of the skill behaviors. As shown in the graph, performance in addition increased dramatically with acquisition of skill behaviors. By the third day of intervention, addition performance had reached 100 per cent accuracy.

The time series design does not afford the opportunity to determine which of the intellectual skill behaviors trained was responsible for producing change in criterion task performance. Of course, in the event that a psychologist were to have the opportunity to work on more than one case of the same general type, it would be possible to vary the composition of and/or the number of intellectual skills designed to produce the desired outcome.

There are several advantages to the consultation approach to intellectual skill training: One is that it provides data showing the functional relationship between the teaching of skills and the accomplishment of the criterion task with which the teacher is concerned. With the aid of an appropriate graph, the teacher is afforded the opportunity of observing the effects of intellectual skill training on criterion task performance. The notion that students should be taught principles with broad applicability rather than isolated facts has long been held by educators as a most desirable outcome of the teaching process. If teachers are expected to teach for transfer, they must be given technics to observe transfer when it occurs. The intellectual skills training procedure outlined above provides one technic for observing transfer.

Another advantage to consultation procedures is that they provide a means to validate the applicability of research findings in applied settings. Experimental findings in much of educational research are based

on differences in group means. There is no guarantee that procedures experimentally validated by group differences can be applied with success to the individual child. Furthermore, numerous variables which may not be present in a controlled laboratory setting may influence the effectiveness of an experimentally validated procedure in the classroom. For these reasons it is useful to have some check to determine whether or not procedures suggested by research are indeed having the effects they are purported to have when they are applied in the schools.

Another benefit of consultation is that it provides data which can serve as a means for generating hypotheses which might form the basis for controlled laboratory research. For example, data such as those presented in Jimmie's case could be used to generate a number of studies on factors facilitating performance in addition.

The efficiency and practicality of the time series design represents still another advantage to consultation procedures. The efficiency of the design is clearly illustrated when it is compared with multiple baseline procedures or designs requiring reversals such as those often used in operant research. Reversal procedures are often impractical in applied settings. For example, one probably could not and would not want to use reversals in the teaching of intellectual skills. Multiple baseline designs are much more complex than the time series procedures used in consultation, although they may be useful in applied settings if adequate resources (i.e. personnel) are available to implement them.

Another advantage to consultation is immediacy of application. A staggering amount of research will be necessary before it will be possible to provide education with even an initial set of empirically validated learning hierarchies on a broad scale. Development and dissemination

are never ending processes costly in both time and money. There is and will continue to be a need to get psychological principles into the schools more quickly than is possible through materials development. Consultation procedures can, as in the example above, be used even in circumstances in which research identifying skill behaviors is lacking. And of course, they can be used to apply research findings which have not as yet been incorporated into packaged materials.

A final advantage to consultation is that the approach requires that the problem which intellectual skill training is to assist in solving be identified in performance terms. Kaufman (1970) points out that the practice of implementing solutions to problems which have never been identified is not uncommon in education. Kaufman's point is certainly well taken with respect to the handling of problems of intellectual competence. Consider the possible ways in which cases like Jimmie's are typically handled in schools. Had little Jimmie's referral been dealt with by traditional school psychological services, the most likely course of action would have been to give him an intelligence test along with other psychological measures. If he had received a low score on the test, a decision might have been made to place him in a special class. A second likely outcome of referring Jimmie for psychological services might have been that Jimmie would have been given a diagnostic ability test. In the event that he received low scores on some subtests, a training program would have been devised to improve his competencies with respect to those subtests. Neither of these procedures require that the problem which initially caused the teacher to seek assistance be specified. It seems obvious that when the problem is not specified, there is not much chance that it will be solved.

There is an important philosophical difference between the consultation approach to the use of intellectual skills and the ability testing approaches mentioned above. The consultation approach places emphasis on moving toward a goal. The important questions to be answered basically are: Where do you want to go? What do you need to do to get there? and How do you know when you have arrived? The emphasis on evaluation in the consultation paradigm is on the accomplishments of the child, not on his deficits. There is no need to label a child as retarded or to say that he has a learning disability in order to apply an intellectual skills approach to teaching. Children being taught intellectual skills behaviors in the Follow Through Project seem to view the psychologist's evaluation of their behavior positively because that evaluation specifies their progress toward a goal, not their disabilities.

Conclusion

The central importance of both the concept of intellectual abilities and the concept of intellectual skills is that they identify factors which underlie the accomplishment of significant tasks within a culture. To say that a person learns academic material quickly because he has a good memory, or that he writes well because he is creative, is to say that there is something present in his behavior which has a determining influence on his effectiveness in task performance. To accomplish the goal of classifying people in terms of intellectual competence, it was sufficient to label that something as an internal set of traits called abilities.

The need for identifying intellectual capabilities is even greater with respect to the aim of changing intellectual competence than it has been with respect to the goal of classifying competence. The purpose for

identification, however, has changed. Whereas, in the past it was sufficient to identify individuals who possessed behaviors underlying task accomplishment, it is now necessary to identify the behaviors themselves and their functions so that competencies can be taught. This shift in purpose demands a shift in the concepts and conventions used to define intellectual capability. Needs for selection continue to exist in society. In consequence, the notion of intellectual abilities remains viable. The concept of intellectual skills advanced in this article would augment the ability concept to make the definition of intellectual competence responsive to the goal of developing human intellect.

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Footnotes

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Figure Captions

Figure 1. Changes in addition performance associated with changes in performance of intellectual skill behaviors